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| **Al-FARABI KAZAKH NATIONAL UNIVERSITY**Faculty of Mechanics and Mathematics**Department of Mathematical and Computer Modeling****SYLLABUS** Stochastic Modeling in Industry Autumnal semester (First half-year) 2016 – 2017 academic year, the magistrates, 1 course  |
| **Course code** | **Course name** | **Type** | Hour per week  | **Credits**  | **ECTS** |
| **Lecture**  | **Seminar** | **Laboratory**  |
|  | Stochastic Modeling in Industry | ED | **2** | **1** | **0** | **3** | **5** |
| Prerequisites | Mathematical Analysis, Algebra and Geometry, Information Science, Probability Theory and Mathematical Statistic, Stochastic Processes, ODE, PDE, Numerical Methods, Calculus, Calculations, Computations.  |
| **Lecturer**  | **Kanat Shakenov, Doctor of Physical and Mathematical Sciences, Professor**  | **Office-time** | According to timetable |
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| **Phone**  | **+7 727 2211591, +7 705 182 3129** | **Lecture hall**  | **418** |
| **Teacher (laboratory studies)** | **Saule1 Zamanova** **+7 701 773 0010** |  |  |
| **e-mail:** | **saule\_zamanova@mail.ru** | **Lecture hall** | **304** |
| **Course description** | Research of the stochastic models and theirs computer simulation.  |
| **Course aims** | Destination of the course: construction of the stochastic models and computer realization.  |
| **Learning outcomes**  | 1. Intimate knowledge of the stochastic models.
2. Ability simulate of the stochastic process.
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| **References and resources**  | 1. Robert C.P., Casella G. Monte Carlo Statistical Methods. Second Edition. Springer. 2005.
2. Himmelblau D. Process Analysis by Statistical Methods. John Wiley and Sons, Inc. New York-London-Sydney-Toronto 1970.
3. Bharucha-Reid A.T. Elements of the Theory of Markov Processes and Their Applications. MC Graw-Hill Book Company, Inc. New York Toronto London 1960.
4. Sobol’ I.M. Monte Carlo Method. Moscow, Nauka. 1985.
5. Shakenov K.K. Monte Carlo Methods and Thiers Application. Almaty, al-Farabi Kazakh State National University. 1993.
6. Feller W. An Introduction to Probability Theory and its Applications. Volume 1. John Wiley, New York. 1970. Volume 2. John Wiley, New York. 1971.
7. Novosselov A.A. Modeling of financial risks. The series of lectures for students of Institute of Mathematics Siberian Federative University, Archives, Krasnoyarsk, 1998.
8. Mitropolsky A.K. Technique of statistical calculations. Moscow, Nauka. 1971.
9. Kenneth M. Case, Paul F. Zweifel. Linear Transport Theory. Addison-Wesley Publishing Company. Reading, Massachusetts – Palo Alto – London – Don Mills, Ontario. 1967.
10. Chandrasekhar S. Radiative transfer. Revised edition. New York. 1960.
11. Hisashi Mine and Shunji Osaki. Markovian Decision Processes. American Elsevier Publishing Company, Inc. New York 1970.
12. Maurice G. Kendall, Alan Stuart. The Advanced Theory of Statistics. In three volumes. Volume 3. Design and Analysis. And Time-Series. Second Edition. Charles Griffin & Company Limited. London.
13. Hennequin P., Tortrat A. Probability Theory and some their Applications. Masson Publishing Company.
14. Ben W. Bolch, Cliff J. Huang. Multivariate Statistical Methods for Business and Economics. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1968.
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| **Course organization**  | Structure of the course: 1.Lectures, 2. Laboratory**.** At a lectureto give the theoretical materials.At a laboratory to give stochastic calculations on PC. The homework may be preset (specified) according to the requirements. |
| **Course requirements**  | 1. The students at first of theoretical materials (lectures) attend. They must to know theoretical materials. 2. Next, to conduct PC Laboratory. Student with PC must construct the numerical model and graphic plot. 3. Student on one's own (or with teacher) must know how computational process analyses. To draw a right conclusion and the model identify.
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| **Grading policy**  | **Description of assignment** | **Weight**  | **Learning outcomes** |
| Individual tasksGroup projectAnalytical problem Examinations. Total | 35%10%15%40%100% | 1,2,34,5,62,3,44,5,61,2,3,4,5,6 |
| Your final score will be calculated by the formula $$The final grade on discipline=\frac{LC1+LC2}{2}∙0,6+0,1MT+0,3FC$$Below are minimum grades in percent:95% - 100%: А 90% - 94%: А-85% - 89%: В+ 80% - 84%: В 75% - 79%: В-70% - 74%: С+ 65% - 69%: С 60% - 64%: С-55% - 59%: D+ 50% - 54%: D- 0% -49%: F |
| **Discipline policy** | All work must be performed and defend within a specified time. Students who do not pass a regular job or received for his performance at least 50 % of points, have the opportunity to work on additional specified job schedule. Students who missed labs for a good reason, and spend their extra time in the presence of a laboratory, after the admission of the teacher. Students who have not complied with all types of work for the exam are not allowed. Also, take into account when assessing the activity and attendance of students during class Be tolerant and respect other people's opinions. Objections formulated in the correct form. Plagiarism and other forms of cheating are not allowed. Unacceptable prompting and copying during delivery SSS intermediate control and final exam, copying solved problems others, exam for another student. Student convicted of falsifying any information rate, unauthorized access to the Intranet using cribs, with a final grade «F».For advice on the implementation of independent work (SSS), and surrender their protection as well as for more information on the studied material and all other emerging issues by reading a course, contact the instructor during his office hours. |
| **Discipline schedule** |
| **Week**  | **Topic** | **Number of hours** |  **Maximum grade**  |
| **1 – 2**  | **Lecture 1 – 4.** ElementaryProbability Theory.Probability. Examples. Definition and illustrations. Deductions from the axioms. Independent events. Arithmetical density. Examples. Exercises. Random Variables. Examples. Definition of Random Variables. Distribution and Expectation. Definition of Mathematical Expectation. Examples. Integer-valued random variables. Examples. Random variables with densities. General case. Exercises. [1], [4], [5].  | **4** | **8** |
| **1 – 2** | **Seminar 1 – 2.** Distributions.Equiprobability distribution, Even/uniform distribution,Binomial, Poisson, Geometric, Cauchy, Conditional, Conjugate, Dirichlet, Discrete, Exponential, Generalized inverse normal, Generalized inverse Gaussian, Isotropic vector in 3D space. [1], [4], [5]. | **4** | **8** |
| **1 – 2** | **Students self-instruction (SSI) by subject (Homework, Project beginning etc.) 1 – 4.**Any kind type of RVG. Computer simulation.  |  | **4** |
| **3 – 4** | **Lecture 5 – 8.** Methods of simulations of random variables. Pseudo-Random Number Generator. Uniform Random Variable on the interval . Uniform Simulation. Algorithm a Uniform Pseudo-Random Number Generation. The Inverse Transform. Optimal Algorithms. General Transformation Methods. Accept-Reject Methods. The Fundamental Theorem of Simulation. The Accept-Reject Algorithm. Problems. Random Walks. Markov Chains. Transition probabilities. Basic structure of Markov chains. Stochastic Process. [1], [4], [5]. | **4** | **8** |
| **3 – 4** | **Seminar 3 – 4.** Random Walks. Markov Chains. Computer simulation of Markov Chains. Others Stochastic Process. | **4** | **8** |
| **3 – 4** | **SSI 3 – 4.** Computer simulation of Markov Chains. Linear and Nonlinear Stochastic Process. Approximation and Computer simulation some Linear and Nonlinear Stochastic Processes by Markov Chains. [6], [11].  |  | **4** |
| **5 – 6** | **Lecture 9 – 12.** Queue System Modeling.Algorithm of calculations. Quality of product calculations. The Ruin of Gambler Problem. Markov Chains in Economics. [7], [13].  | **4** | **8** |
| **5 – 6** | **Seminar 5 – 6.** Computer simulation of the Poisson distribution (Poisson flow) and others random parameters. Calculations of probabilistic characteristics of product.  | **4** | **8** |
| **5 – 6** | **SSI 5 – 6.** Computer simulation others random parameters. |  | **4** |
| **7** | **Lecture 13 –14 .** Calculations of neutron passing through of plate. Problem statement. Breakdown of calculation by modeling of real trajectories. Reactor calculation and protection. [4], [5], [9], [10]. | **2** | **4** |
| **7** | **Seminar 7.** Computer simulation.  | **2** | **4** |
|  | **SSI 7.** Reactor calculation and protection.  |  | **2** |
|  | **IC 1** |  | **100** |
|  | **Midterm Exam** |  | **100** |
| **8** | **Lecture 15 –16.** Construction andAnalysis of Empirical Models. Estimation when Dependent Error of Measuring’s. Correlated remains. Durbin – Watson Criterion of Serial Correlation. Example. Strategics of Effective Experimentation. Canonical Analysis for Plastic Extruder. Example. [2]. | **2** | **4** |
| **8** | **Seminar 8.** Example 4.6.2. Example 8.2.3. [2]. | **2** | **4** |
| **8** | **SSI 8.** Linear Models with one variable. Strategics of Effective Experimentation. |  | **2** |
| **9 – 10**  | **Lecture 17 –20.**  BernoulliBinomial Distribution and their Applications. [8].Poisson Distribution and their Applications. [8]. | **4** | **8** |
| **9 – 10**  | **Seminary 9-10.** Technical characteristics of materials. [8], Enclosure 1. | **4** | **8** |
| **9 – 10**  | **SSI 9 –10.** Technical characteristics of materials. [8], Enclosure 1. |  | **4** |
| **11 – 12**  | **Lecture 21 – 24.** Estimation Methods.Significance Test. Estimation of Parameters. Statistics Distribution. Criterion of Independence and Fitting Criterion. Estimation of Mean and Variance. Estimated of Correlation Coefficient. [8]. | **4** | **8** |
| **11 – 12** | **Seminary 11 – 12.** Variance Analysis.Sequential Analysis. Criterion for Randomness. | **4** | **8** |
| **11 – 12** | **SSI 11 – 12.** Correlational Equations.  |  | **4** |
| **13 – 15** | **Lecture 25 – 30.** Correlation. Variance Analysis. Covariance Analysis. Variance Analysis. One-Way Classification. Example. Two-Way Classification. Example. Covariance Analysis. Example. [14].  | **6** | **10** |
| **13 – 15** | **Seminary 13 – 15.** Fundamental Programs: GRAND, COLS, FCAL. Computer simulation of elementary models. [14]. | **6** | **10** |
| **13 – 15** | **SSI 13 – 15.** Computer simulation of elementary models. [14]. |  | **6** |
|  | **IC 2** |  | **100** |
|  | **Exam**  |  | **100** |
|  | **Total** |  | **100** |

**Reviewed at the department meeting**

***Report №\_\_ from «\_\_» \_\_\_\_\_\_\_\_\_\_\_\_2017***

**Head of department D. Zhakebayev**

**Lecturer K. Shakenov**